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Reexamining Teacher Preferences and Compensating Wages*

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Abstract — This paper reexamines the question posed by Antos and Rosen (1985) *J. Econometrics* **3**, 123–150. "How much is required to induce white teachers to teach in black schools?" Estimates from the model suggest that standing alone, percent nonwhite students is an excellent predictor of teacher salary differentials. However, percent nonwhite students appears to be highly correlated with the level of poverty (positively) and with students' test scores (negatively). Teachers seem to demand higher wages to teach less wealthy, lower-achieving students, not necessarily nonwhites. More importantly, variables for community social and economic status yield significant positive coefficients, suggesting that districts demand different amounts of education such that demand-side wealth effects negate supply-side compensating wage effects.

IN 1966 James Coleman *et al.* concluded from the Equality of Educational Opportunity Survey (EEOS) that "the race of [the] student is a small factor in the salaries of teachers, if a factor at all" (Coleman *et al.*, 1966). Several economists, even some using Coleman's data, have since drawn different conclusions by estimating wage equations which measure the compensating wage teachers demand to work in schools with more nonwhite students.

Eric Toder studied racial discrimination using 1968 data from Massachusetts (Toder, 1972). He estimated the implicit wage teachers demanded to teach black students at $25 a year for every percentage point increase in the black student population. But there might be several problems with Toder's study. Collinearity between his "central city" and "race" variables appears to be one such problem. Toder's $25 estimate may capture, for example, the higher cost of living in Boston. Also, the dependent variable is the average salary for all teachers in a school system. This includes teachers who may have been in the system for years, bound by the institutional constraints of the internal labor market and not making the same marginal decisions that starting teachers are.

Joseph Antos and Sherwin Rosen conducted the seminal study of compensating wage differentials for racial discrimination (Antos and Rosen, 1975). They used data from the EEOS and a model similar to Toder's, in which students' race was the only school characteristic variable, to estimate an implicit yearly salary premium for teaching nonwhite children of about $6 per percentage point increase in the nonwhite enrollment. However, when Antos and Rosen included measures of student ability and motivation, curriculum quality, and neighborhood and regional desirability, the race coefficient became wrong-signed and insignificant, indicating a collinearity between the race variable and other school characteristics.

Antos and Rosen's findings leave room for several theoretical and empirical improvements. Like Toder they included all teachers, measuring other than marginal decisions. They also treated individual schools as the competitive employers of teachers,

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when in fact districts make the hiring decisions. Newly hired teachers are assigned to specific schools within the districts which hire them, and usually have little choice in the process. Antos and Rosen also assumed perfect equilibrium in the labor market, which is often not the case. The 1970s were years of rising real teachers' wages and surplus teacher applicants. In the 1960s, when Antos and Rosen's data were collected, real wages were falling and teacher shortages were a chronic problem (Murnane, 1984). To measure the true implicit wage associated with racial discrimination, the market must be as close to equilibrium as possible.

THE LABOR MARKET FOR TEACHERS

Traditional labor market paradigms must be applied with caution to the educational labor market. Because less efficient schools are not forced out of the market, as inefficient firms would be, schools cannot be assumed to minimize costs. Demand-side downward pressure on wages originates in community aversion to high taxes, and the political motives of local officials, not from competition. Supply-side upward wage pressure comes from competition between employers for employees. To the extent that there are a large number of closely located school districts, competition can be assumed. Due to the importance of teachers to educational production, the demand for teachers may be modeled as simply dependent on the size of the school-age population (Zarkin, 1985).

Once within school systems, however, teachers face very rigid internal labor markets. Teachers are promoted and transferred among schools on the basis of seniority. Naturally, senior teachers gravitate towards better schools. Since senior teachers are better paid, regardless of ability, better schools face higher salaries. So while the external educational labor market may be competitive, the internal market is not. Only newly hired teachers make clearly marginal decisions, and employers make marginal decisions only about newly hired teachers.

Discrimination

If all teachers were indifferent to the race of their students, all else being equal, they would be paid equally and distributed randomly among schools. But all teachers may not be completely open-minded. Some researchers, like Antos and Rosen, have argued that the distribution of teachers and salaries depends on the percent of nonwhite students and the degree of discrimination among teachers. White teachers who prefer to teach white students may demand higher salaries to work in black schools. If there are enough nondiscriminating teachers to fill all positions in black schools, then there should be no measurable pay differential, as it will be absorbed by a segregating effect among teachers. If, however, there are not enough indifferent teachers to fill vacancies at black schools, then those schools must pay a premium to attract discriminating teachers. That premium is the compensating wage differential that this paper attempts to measure.

A Model of Teacher Salary Determination

Two economic theories suggest particular types of independent variables to include in wage equations: human capital theory and compensating wage differential theory (Duncan, 1976). Most human capital models include some combination of age, experience, and education variables. Compensating wage differential models are based on qualitative job characteristics, such as working conditions, and underlie the issue of race-based salary differences. Simply stated, tougher or more unpleasant jobs should pay higher wages, all else being equal. Thus, if teachers view teaching nonwhites as less desirable, it should be possible to measure the implicit wage they demand to do so.

However, there is an important difference between traditional labor markets and educational labor markets regarding compensating wage theory. It is normally assumed that employers, by incurring costs, can adjust the amount of disagreeable job qualities so as to maximize their profits. But school districts have no control over the characteristics of their students. Thus, as shown in Fig. 1, the lower envelope of workers' indifference curves delineates the set of equilibria between teacher wages and the percent nonwhite students. Where this market equilibrium function meets the vertical lines representing the percentage of nonwhites in districts, jobs are created. Given this distribution of white and nonwhite students, all of the variation in wages is due to teacher preferences.

Market equilibrium in the educational labor market also differs from that of other markets because there can be no supply response to educational cost increases. Every child must attend

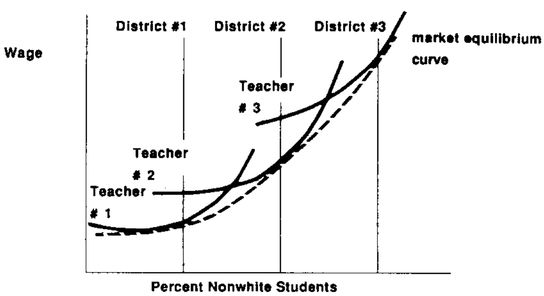

Figure 1.

school. The most an administrator can do is lower educational quality, either by increasing student–teacher ratios or by hiring less able teachers.

Because of this possible quality difference, shown in Fig. 2, care must be taken in evaluating observed salary differentials across districts. Observed wage differentials will reflect quality differences most simply if there is only one supply curve. If supply curves differ across districts, then salary differentials will be diminished to the extent that teacher quality changes. Only by accurately accounting for teacher quality, can valid conclusions about educational cost differentials be drawn.

A distinction must be drawn here between a community's obligation to pay more for education, and its ability or desire to do so. The former is the result of community characteristics which raise education costs, such as compensating wage differentials to teachers. The latter stems from wealth inequality between districts financed largely by local taxes. Teacher salary differences that arise for these reasons are not discriminatory, but they do affect the measurement of compensating wage differentials. Good community characteristics, which should

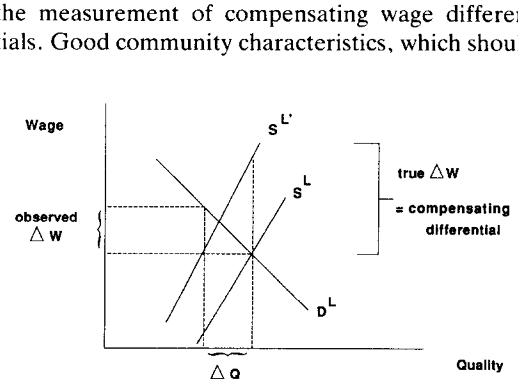

Figure 2.

have negative implicit wages, tend to be associated with wealthy districts that are able to pay higher salaries. Bad community characteristics, which should have positive implicit wages, tend to be found in poor districts, which are unable to pay high teacher salaries. These two effects may cancel each other out. In economic terms, while districts face different labor supply curves, teachers may face different labor demand curves.

The problem here is identifying the labor supply curve because several of the inputs to the labor supply equation may also be determinants of the demand for teachers. Likely inputs to both equations are variables describing community characteristics, such as wealth. The coefficients to these variables will be biased, depending on the size and direction of the demand effect. The wage equation I estimate is thus, by necessity, a reduced form. Data and algebraic obstacles prevent the estimation of a structural form which would make the interpretation of results less ambiguous. However, estimating the reduced form wage equation is still worthwhile, given that previous studies of this issue took this form.

NEW EMPIRICAL FINDINGS

I have reestimated an implicit wage index for teachers, altering Antos and Rosen's model in several ways.

(1) I used only data on first-year teachers to more closely approximate marginal decision-making by both teachers and administrators.

(2) I tried four indices of the quality of the college the teacher attended as proxies for "teacher quality", settling on Toder's dummy for teachers from Michigan.

(3) I modeled school district characteristics rather than individual school characteristics, since new teachers are hired by districts and are not usually free to choose among particular schools.

(4) I used data from 1970, a year between the excess teacher demand of the 1960s and the excess supply of the 1970s, to more closely approximate labor market equilibrium.

(5) I used objective test score results for students, where Antos and Rosen used self-reported scores.

(6) I experimented with different functional forms, including squared percent nonwhite values to try to capture changing discrimination at different percentages of nonwhite students.

Table 1. Descriptive statistics

Variable	Mean	Std Dev.	Min	Max	Obs
SALARY	7945.945	967.062	4625.00	23,000.00	5617
AGE*	25.696	5.818	21.00	70.00	5615
FEMALE	0.729	0.444	0.00	1.00	5617
MADEGREE	0.056	0.230	0.00	1.00	5617
INSTATE	0.846	0.361	0.00	1.00	5617
HISCHOOL	0.242	0.428	0.00	1.00	5494
RATIO	24.637	1.972	17.99	36.07	5617
PCPROFES	0.050	0.022	0.01	0.17	5549
MEDINC	11,461.514	2247.923	5981.00	24,574.00	5549
ENROLL	28,632.813	70,420.018	317.00	293,822.00	5617
READSCORE	50.353	2.780	41.00	59.00	5617
PCPOOR	0.087	0.059	0.01	0.34	5549
PCNONW	0.105	0.189	0.00	0.80	5617

*The 70 year old teacher was discarded as an outlier.

The school district characteristics come from the 1970 Census, 4th and 5th counts, reported according to school district in Michigan. The human capital data, the teacher characteristics, come from a Michigan Department of Education survey, also conducted in 1970. The dependent variable in this model, SALARY, is first-year teachers' starting salaries, as reported by the 1970 Department of Education survey.

The first set of independent variables measures teachers' human capital. Richard Murnane has listed teachers' human capital as: on-the-job training, formal training, and intellectual ability (Murnane, 1983). I have controlled for on-the-job training by limiting the study to first-year teachers. Formal training is measured by the dummy variable MADEGREE, indicating teachers with an M.A. or higher. Intellectual ability proved to be the most difficult human capital variable to measure. I ran wage regressions using four different measures of college quality as a proxy for school administrators' perceptions of new teacher quality: Jack Gourman's index (Gourman, 1967), Donald Winkler's dummy for teachers from "prestigious" colleges (Winkler, 1975), James Cass and Max Birnbaum's college selectivity index (Cass and Birnbaum, 1981), and Toder's dummy variable for teachers from out-of-state colleges.[1] None of these variables proved significant, and only Toder's dummy (which I call INSTATE, for teachers from colleges in Michigan) yielded a coefficient with the expected negative direction.

The last two independent variables included in most human capital models are age and sex. The age variable in this case can be thought of as a proxy for experience at other jobs, and should have a positive coefficient. Sex is included because women often face discrimination. In sum, there are four human capital variables in this model: MADEGREE, INSTATE, AGE and FEMALE.

Much more complicated than the human capital variables are those that measure characteristics for which teachers demand implicit wages. The level of instruction appears in some teaching wage models (Baugh and Stone, 1982). To attract teachers able and willing to teach more students and more demanding subjects, high schools should pay more than elementary schools. I include a dummy variable, HISCHOOL, to examine this possibility. Another important characteristic is class size since teachers can be assumed to prefer working with smaller groups of students. Antos and Rosen used classrooms per student, highly correlated with student–teacher ratios, and found a very small but significant relationship. I have included RATIO, the district-wide student–teacher ratio, in the model.

The characteristics of the surrounding community probably also play a role in determining teachers' implicit wages. Data on the percentage of professional and technical workers in a community, PCPROFES, should provide a measure of both the educational background of parents, and of their "social status". Data on median household incomes, MEDINC, more specifically describe the community's economic status. (Note that this is a variable likely to capture some demand effects.) Community size may influence teacher salaries as well. Although no theory predicts the direction of the implicit wage for size, Antos and Rosen found a large but insignificant positive correlation between enrollment, ENROLL, and salaries. I expect this variable will capture much of the difference of Detroit from the rest of the sample. Detroit has higher starting salaries, enrollments, student–teacher ratios, and percent nonwhite and poor students, and lower average reading test scores than the rest of Michigan's districts. Toder accounted for Boston in his Massachusetts study by including a dummy variable for the Boston school district. Not surprisingly, he found Boston to have a large and highly significant positive influence on teachers' salaries.

More important to this study than school or community characteristics are the attributes of the students themselves. Brazer and Anderson (1973), who also studied Michigan's schools with 1970 data, found no relationship between teacher salaries and fourth grade students' basic skills achievement test scores. However, like Antos and Rosen and Toder, Brazer and Anderson include all teachers in their sample, which should tend to lower observed implicit wages. Antos and Rosen measured significant positive coefficients to their student ability variable, a twelfth grade verbal test score. This may be a result of Antos and Rosen's data (their inclusion of all teachers, the shortage of teachers in 1965, or the self-reported test scores). Or it may indicate that districts have independent labor demand curves. Better students may be coming from communities which place more emphasis on education and are willing to pay higher salaries. I use READSCORE, a seventh grade reading test score, to examine these effects.

A second measure of student characteristics, students' families' wealth, has usually been estimated indirectly, through community statistics. Antos and Rosen derived insignificant coefficients from variables estimating the number of students receiving free lunches. Brazer and Anderson found a significant but very small coefficient to the proportion of children in families with incomes less than $3000. I use PCPOOR, the percentage of students whose families' incomes fall below the Orshansky poverty index (Orshansky, 1977).

Finally, the race of the teacher and of the students must be accounted for. PCNONW measures the percent nonwhite students in the district. For the teacher, rather than include a dummy variable for race, I chose to estimate the model separately for whites and nonwhites, emphasizing the much larger size of the former group.

The model presented here is, by necessity, a product of both theory and experimentation. Several included variables, such as PCPOOR, may measure both supply and demand conditions such that only qualitative conclusions may be drawn about their effect. The coefficient of PCNONW, however, almost certainly measures only supply effects. As Robert Smith (1979) noted, the shape of the implicit wage curve is not determined theoretically. Nor in this case does it appear to matter empirically. (A linear estimation of Model Two generates a slightly higher R-squared and slightly less significant coefficients. Including squared PCNONW produces a virtually identical fit.) The functional form discussed here is log-linear; the log of teacher salaries is regressed on the independent variables.

Model One: Percent Nonwhite Students Explains All

Following Antos and Rosen, I first estimated a model in which percent nonwhite students was the only school descriptive variable. The human capital variables, AGE, FEMALE, and MADEGREE, are all significant in the expected direction. The level of instruction, HISCHOOL, produced a small insignificant coefficient.

The differences between the two samples are quite interesting. Nonwhite teachers receive much more compensation for graduate education than white teachers. This may explain why proportionally many more nonwhite teachers acquired M.A.s.

Table 2. Model One: Ordinary least squares estimation — dependent variable: ln(SALARY) (Standard errors in parentheses)

	WHITES		NONWHITES	
CONSTANT	8.9194†	(0.0063)	8.6562†	(0.0290)
AGE	0.0017†	(0.0002)	0.0114†	(0.0009)
FEMALE	−0.0104†	(0.0025)	0.0183	(0.0138)
MADEGREE	0.1147†	(0.0053)	0.2041†	(0.0186)
INSTATE	−0.0040	(0.0033)	−0.0309*	(0.0122)
HISCHOOL	0.0003	(0.0026)	0.0128	(0.0144)
PCNONW	0.1166†	(0.0069)	0.1456†	(0.0276)
Adjusted R^2 =	0.171		0.615	
Degrees of freedom =	5081		329	
F statistic =	176.07		90.18	

* Significant at $\alpha = 0.05$.
† Significant at $\alpha = 0.01$.

Similarly, nonwhite teachers from out-of-state colleges are rewarded more than white teachers, and more nonwhite teachers are from colleges outside Michigan.

PCNONW yielded a large and significant coefficient for white teachers. But note that the larger and equally significant coefficient for nonwhite teachers immediately casts doubt on the model. This strongly suggests that PCNONW is measuring other job characteristics for which teachers demand implicit wages. If race were the true characteristic, then nonwhite teachers should at least be impartial to teaching nonwhite students. To measure the effects of nonwhite students correctly, all of the other compensating wage variables must be added to the model.

Model Two: Percent Nonwhite Disappears

Model Two adds to Model One RATIO, PCPROFES, MEDINC, ENROLL, READSCORE and PCPOOR, attempting to explain more of the apparent discrimination. As a result of the new explanatory variables, the percent nonwhite coefficient shrinks in the white sample, and disappears from the nonwhite sample. As before, AGE FEMALE, and MADEGREE are all significant at $\alpha = 0.01$ (for the white sample). Once again, the differences between the white and nonwhite samples are enlightening. Nonwhite teachers maintain their much higher return to schooling and age. The nonwhite model's larger R-squared may be the result of the high percentage of nonwhite teachers sampled from Detroit. While some of the job characteristic coefficients reflect the compensating wage theory, others do not. Coefficients on the measures of median family incomes, student reading test scores, and percent poor students (MEDINC, READSCORE, PCPOOR) all have signs opposite to compensating differential expectations. Rather than suggesting that teachers prefer poor neighborhoods, or lower-achieving and less wealthy students, these variables seem to require an entirely new interpretation.

If it is true that communities have different demand functions for education, then we should expect wealthier, more education-conscious communities to be able and willing to pay teachers higher salaries. It is possible that these variables can be interpreted as capturing differences in teacher quality. Wealthy, education-conscious communities may just hire better teachers.

Model Three: Percent Nonwhite Explained

Regressing the percent nonwhite students on five related student, school, and community descriptive variables from Model Two partly accounts for

Table 3. Model Two: Ordinary least squares estimation — dependent variable: ln(SALARY)
(Standard errors in parentheses)

	WHITES		NONWHITES	
CONSTANT	8.7259†	(0.0391)	8.1275†	(0.4330)
AGE	0.0011†	(0.0002)	0.0100†	(0.0009)
FEMALE	−0.0151†	(0.0022)	0.0092	(0.0129)
MADEGREE	0.1048†	(0.0047)	0.1855†	(0.0174)
INSTATE	−0.0037	(0.0029)	−0.0198	(0.0120)
HISCHOOL	0.0048*	(0.0023)	0.0212	(0.0135)
RATIO	0.0022†	(0.0006)	−0.0049	(0.0048)
PCPROFES	−0.2794†	(0.0733)	−1.3975†	(0.4824)
MEDINC (1000s)	0.0143†	(0.0008)	0.0163*	(0.0083)
ENROLL (1000s)	0.0004†	(0.0000)	0.0005†	(0.0001)
READSCORE	0.0001	(0.0007)	0.0117	(0.0076)
PCPOOR	−0.0304	(0.0355)	−0.0702	(0.3278)
PCNONW	0.0829†	(0.0136)	0.1447	(0.0869)
Adjusted R^2 =	0.346		0.673	
Degrees of freedom =	5075		323	
F statistic =	225.76		58.56	

* Significant at $\alpha = 0.05$.
† Significant at $\alpha = 0.01$.

Table 4. Model Three: Ordinary least squares estimation — dependent variable: PCNONW (standard errors in parentheses)

CONSTANT	1.3427†	(0.0359)
PCPOOR	1.5017†	(0.0335)
MEDINC (1000s)	0.0171†	(0.0007)
READSCORE	−0.0282†	(0.0006)
ENROLL (1000s)	0.0008†	(0.0000)
RATIO	0.0069†	(0.0006)
Adjusted R^2 =	0.834	
degrees of freedom =	5543	
F statistic =	5593	

†Significant at $\alpha = 0.01$.

PCNONW's disappearance when these same variables are added to Model One. Percent nonwhite is positively correlated with percentage poor students, median incomes, enrollment, and student teacher ratios, and negatively correlated with reading test scores. It might seem surprising that PCNONW should be positively related to median incomes. But most nonwhites probably live in urban districts, Detroit in particular, where average wages are higher. All of these coefficients are significant, and together explain 83% of the variance in the percent nonwhite students, thus accounting for PCNONW's apparent significance standing alone in Model One, and disappearance from Model Two.

CONCLUSION

Despite my expectations to the contrary, Antos and Rosen's twenty-year-old findings still withstand considerable scrutiny. In the absence of other information, percent nonwhite students is a good predictor of teacher salary differences between school districts. At first glance, teachers appear to discriminate against their students on the basis of race. But when more information about working conditions is known, the significance of students' race diminishes for white teachers and disappears for nonwhites.

The remaining compensating wage in the white teacher sample may measure discrimination, but there are other explanations. Data on vandalism, disciplinary problems, age of school facilities, and measures of urbanization might explain even more of the observed discrimination. The race coefficient may also measure commuting costs where housing markets are segregated. On the other hand, several measures of working conditions included in Model Two produced coefficients opposite to compensating wage theory, suggesting that districts have different education demand curves. Wealthy districts with more white students may demand and pay more for better teachers, reversing expected compensating wage effects.[2]

Omitted variable bias and simultaneity bias may negate each other to some extent. In any case, the remaining coefficient, 0.08% per percentage point increase in the nonwhite student population, amounts to a $500 per teacher difference between Michigan's most and least white school districts. Spread over Michigan's 25 to 1 student–teacher ratio, this represents only $20 per student, or a 3% rise in average instructional expense per student. The measured coefficient is significant only in a statistical sense. Inequality of education between school districts cannot be blamed on teachers discriminating on the basis of race.

NOTES

1. The theory behind the out-of-state college dummy is that districts with more out-of-state teachers had more money to recruit nationally, and thus to recruit better teachers.
2. There are two possible ways PCNONW could be biased by a demand effect. If percent nonwhite students has a positive effect on districts' demand for teachers, which seems unlikely, the PCNONW coefficient in this wage equation will be exaggerated. Only if the percent nonwhite students has a negative effect on demand for teachers, which seems even less likely, will the PCNONW coefficient in the wage equation be underestimated due to simultaneity bias.

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